HW 8 – November 15

The **oxidation state or oxidation number** describes the degree of oxidation (loss of electrons) of an atom in a chemical bond. In assigning oxidations number to atoms, we pretend that the electrons are completely transferred from one atom to another (from less electronegative to more electronegative), even though in reality they may be only unequally shared.

<u>The following rules help to determine oxidation numbers:</u>

1) The oxidation state of any free atom is 0

2) The oxidation number of any single atom ion is equal to its charge: H^+ (+), Fe^{3+} (+3), F^- (-), Na^+ (+); in a polyatomic ion, the oxidation numbers add up to the charge of the ion.

3) Some elements have the same oxidation number in almost all their compounds:

- H: +1 (except in metal hydrides like NaH, where it's -1)
- Fluorine: -1
- Oxygen: almost always -2 (unless it forms a simple covalent bond O-O)

4) In a neutral compound, the oxidation numbers add up to zero

Based on these rules we can easily determine the oxidation number of atoms in different molecules. E.g. in H_2S the oxidation number of H is (+1) according to the rule #3. Then we ascribe the oxidation number to S so that the oxidation numbers of 2 H atoms and S atom add up to 0 according to rule #4. This gives the oxidation number of S to be (-2) and the total charge of the compound to be 0 (2x1 (for 2 H atoms) – 2 (for S) = 0).

An atoms oxidation number depends on the other atoms around it.

For instance, in HCl, chlorine acquires one electron (for an oxidation state of -1) because Cl is more electronegative (~ 3.0) than hydrogen (~2.1).

But in the perchlorate ion, ClO_4^-, chlorine has an oxidation state of +7. All its valence (outer shell) electrons go to oxygen, which is even more electronegative (~3.5) than chlorine.

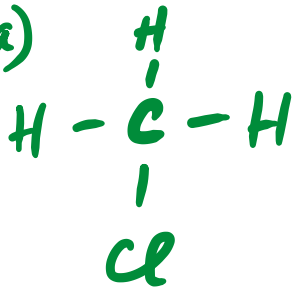
Electronegativity:

Element	Electronegativity	Element	Electronegativity
Cs	0.79	H	2.20
K	0.82	C	2.55
Na	0.93	S	2.58
Li	0.98	I	2.66
Ca	1.00	Br	2.96
Mg	1.31	N	3.04
Be	1.57	Cl	3.16

Si	1.90	O	3.44
B	2.04	F	3.98
P	2.19		

1. Using the table above and the rules for the oxidation number determine the oxidation number of all atoms in the following molecules: $HClO_4$, $HClO_3$, $HClO_2$, HClO, HCl, Cl_2, NH_3, PH_3, H_3PO_4, O_2, O_3.
2. * The oxidation number may be different from the valence. Below are structural formulas of some carbon-containing compounds. Write down molecular formulas of these compounds (like the ones in question #1) and determine oxidation number of carbon atom in each of them:

a)



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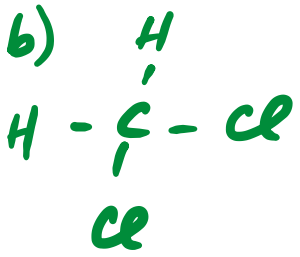

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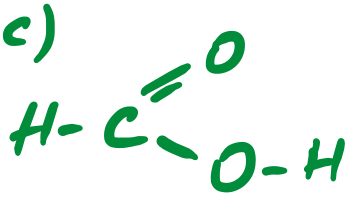

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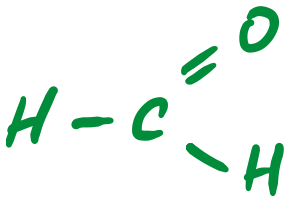

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